

medical systems

adapted for medical use with seals that not only don't leak but are adaptable to a considerable difference in infant size. Further design refinements are necessary and are expected to be completed this year.

Biological isolation garment

A spinoff of the astronaut's biological isolation garment will allow hospital patients who are highly vulnerable to infection to leave their sterile habitats for several hours, carrying their germ-free environment with them.

The garment was designed originally to be worn by astronauts returning to earth until their arrival in a quarantine facility aboard the recovery ship. It was meant to protect the environment against unknown microorganisms from the moon—an unnecessary precaution, it turned out, but one that may become important when men visit the planets.

A prototype isolation garment has been tested in hospitals and by the National Cancer Institute with favorable results. It is a coverall-type suit with attached mittens and slippers, all made out of a penetration-resistant fabric. The fabric prevents penetration of particles greater than 0.3 microns. A separate hood with a transparent face mask is attached to the suit. The entire garment is easily sterilized.

Air is supplied through a diffuser at the top of the head. A flexible tube conducts purified air to the headpiece from a filter-blower system powered by rechargeable batteries. Positive pressure is maintained to prevent unfiltered air from entering the suit.

The garment is an adjunct to patient isolation rooms, becoming an extension of the protected environment. The garments thus can be used in any of some 200 hospitals where isolation rooms are installed to treat leukemia, radiation injuries, burns, respiratory diseases, organ-transplantation patients, and immune-deficient children. Environmental infection can be a serious problem in these cases. For instance, it is responsible for nearly 70% of all deaths in acute leukemia.

While no commercial versions of the garment are yet available, several manufacturers have shown interest in licensing the NASA patent.

Storing blood cells

White blood cells and bone marrow now can be stored for future use by leukemia patients as a result of Goddard and Jet Propulsion Laboratory expertise in electronics and cryogenics—the science of extremely low temperatures.

Drugs and radiation used to destroy cancerous cells during leukemia treatment eventually also destroy bone marrow which produces disease-fighting white blood cells. Previous attempts to develop an adequate freezing system either destroyed the cells by rupture when cooled too quickly or by dehydration when cooled too slowly.

Projecting health needs

NASA's Jet Propulsion Laboratory has developed a computer model for planning future health-care needs in the Los Angeles area. The model integrates demographic, health, and other data to provide rational projections of hospital-bed and physician-specialty requirements.

In designing unmanned spacecraft to explore the planets, the laboratory has gained a unique capability in systems design, operations management, telemetry, and computerized data handling now being applied to health care and other domestic problems.

The NASA computer model provides improved projections when compared with existing models. California is evaluating the NASA Los Angeles model for possible use throughout the state.

Respiratory distress

Some 20,000 babies succumb to respiratory distress in the U.S. each year, a condition in which the lungs progressively lose their ability to oxygenate the blood.

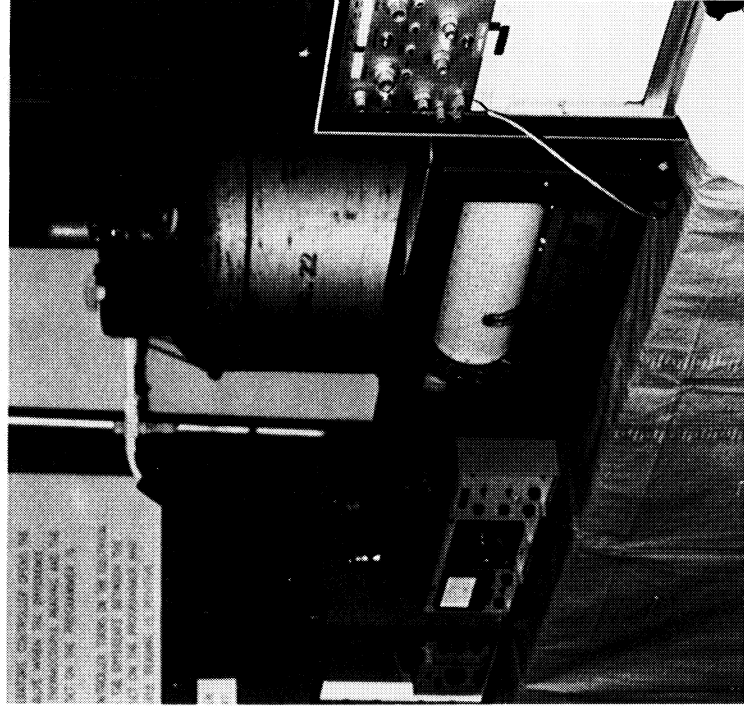
Both positive- and negative-pressure techniques have been used—the first to force air into the lungs, the second to keep the infant's lungs expanded.

Negative pressure around the chest helps a baby expand his lungs and maintain the proper volume of air. If doctors can keep the infant alive for four days by either method, the missing substance in the lungs will usually form in sufficient quantity to permit normal, unassisted breathing.

The University of Miami School of Medicine was among the first to use the negative-pressure technique, and improvised a chamber to cover an infant's upper abdomen, arms, and throat. But a serious problem was encountered: the waist seal leaked excessively and both neck and waist seals caused inflammation and swelling skin.

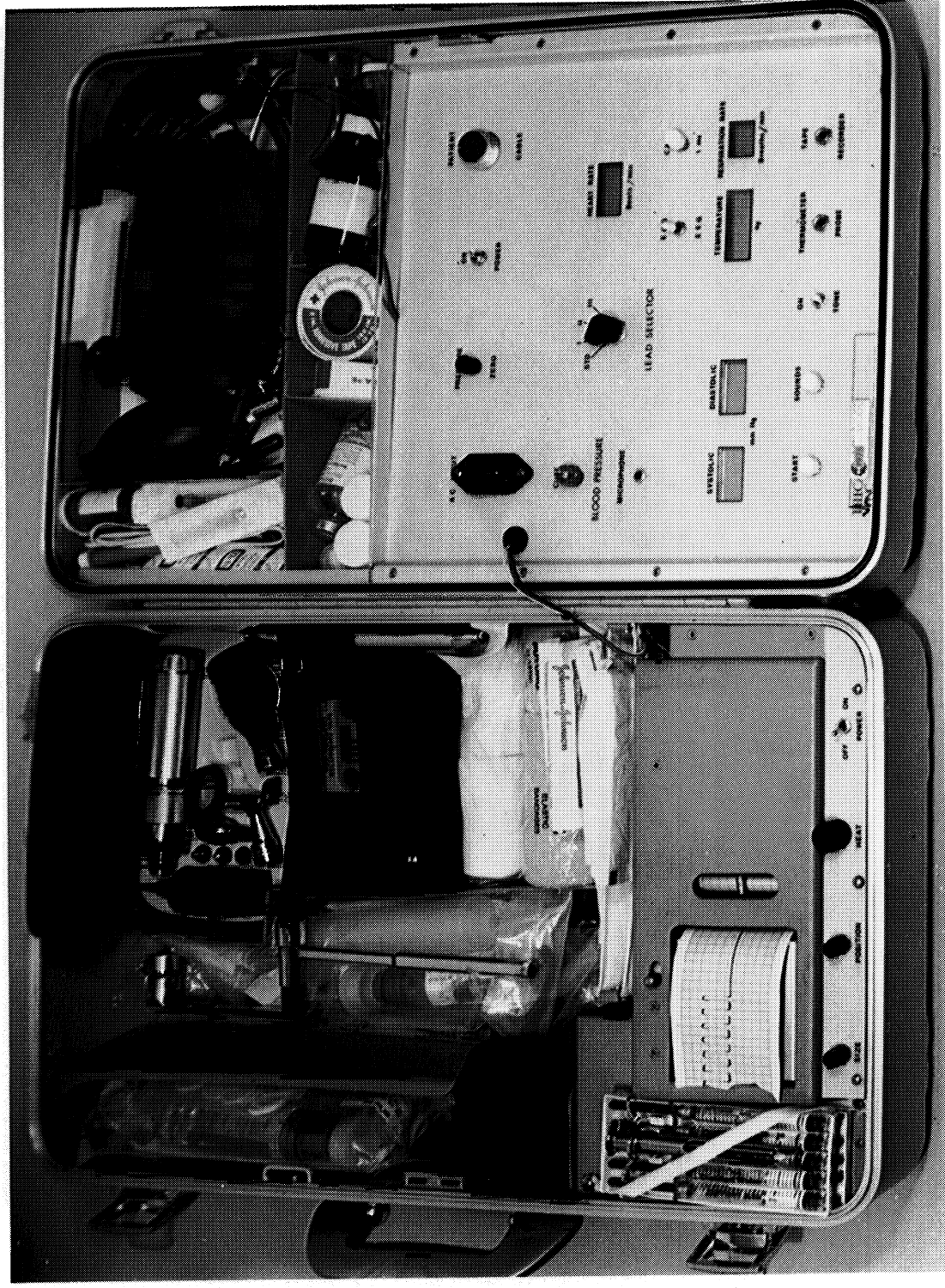
NASA's Research Triangle Institute Biomedical Application Team was asked to assist. The team enlisted Marshall and Johnson engineers to adapt the lower-body negative-pressure system seals used during the Skylab missions. In the weightless and relatively confined conditions aboard Skylab, blood circulation of the legs is restricted. So the astronauts periodically would put their legs into the chamber up to their waist. The slight negative pressure in the chamber increases circulation.

The Skylab chamber and its leakproof seals were



Immune-deficient child leaves hospital sterile room for up to four hours carrying germ-free environment with her in a modification of the astronaut's isolation garment. The garment was developed originally to be worn between spacecraft landings and quarantine as a precaution against carrying unknown microorganisms from the moon. The spinoff is intended for children with aplastic anemia, leukemia, or other disorders requiring a sterile environment.

White blood cell- and bone-marrow bank can be established using freezing unit that emerged from NASA electronics and cryogenics research. Freezing system monitors temperature of the cells themselves and the system maintains a consistent freezing rate. Ability to freeze, store, and thaw white cells and bone marrow without damage is important in leukemia treatment.



Engineers at JPL proposed a solution to the blood-cell freezing problem first identified by the Research Triangle Institute Biomedical Application Team during discussions with the National Cancer Institute. JPL's solution utilized a special electronic circuit developed for precise temperature control of scientific instrumentation now on its way to Mars on board the Viking spacecraft. JPL then turned the idea over to the Goddard engineers for implementation, since the Goddard Center was geographically more convenient to the National Cancer Institute.

The freezing unit monitors the temperature of the cells themselves. A thermocouple placed against a polyethylene container relays temperature signals to an electronics system, which in turn controls small heaters located outside of the container. The heaters allow liquid nitrogen to circulate at a constant temperature and maintain a consistent freezing rate.

Freezing white blood cells is important in leukemia work. There are more than 80 types of white cells, making patient-donor matching difficult. Storage life of unfrozen white blood cells is only a few hours.

The Goddard freezer, which was delivered last year to the cancer institute, can freeze up to 220 ml of white blood cells in one hour. Animal bone marrow also is being frozen by the unit for transplant research. Results so far are encouraging.

Better physician's 'black bags'

There's a limit to what a physician can carry in his "black bag." But NASA-Johnson is extending that limit dramatically by transferring technology accrued through monitoring of astronauts' vital signs.

The development is evolving now in preparation for providing diagnosis and treatment of space-shuttle crew and passengers. Of course it can be adapted to aircraft, shipboard, and physician emergency calls too.

The portable medical-status system contains an electronic vital signs monitor, a cassette machine for recording electrocardiograms and electroencephalograms, equipment for minor surgery, as well as conventional diagnostic instruments such as the stethoscope, and drugs.

The big job was to make it all portable. Liquid-